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(54) Electric drive unit

(57) An electric drive unit, in particular for a windscreen wiper, comprising a motor housing (10) with a gear housing (12) secured thereon. The armature shaft (14) projects into the gear housing (12) and worm gear toothing (16) provided thereon co-operates with a worm wheel (13) mounted in the gear housing (12). The armature shaft (14) is guided in self-adjusting bearings (21, 22), provided on opposite sides of the toothing (16), whereby canting between the shaft and its guide bearings is reduced, if not eliminated, in an economic manner.

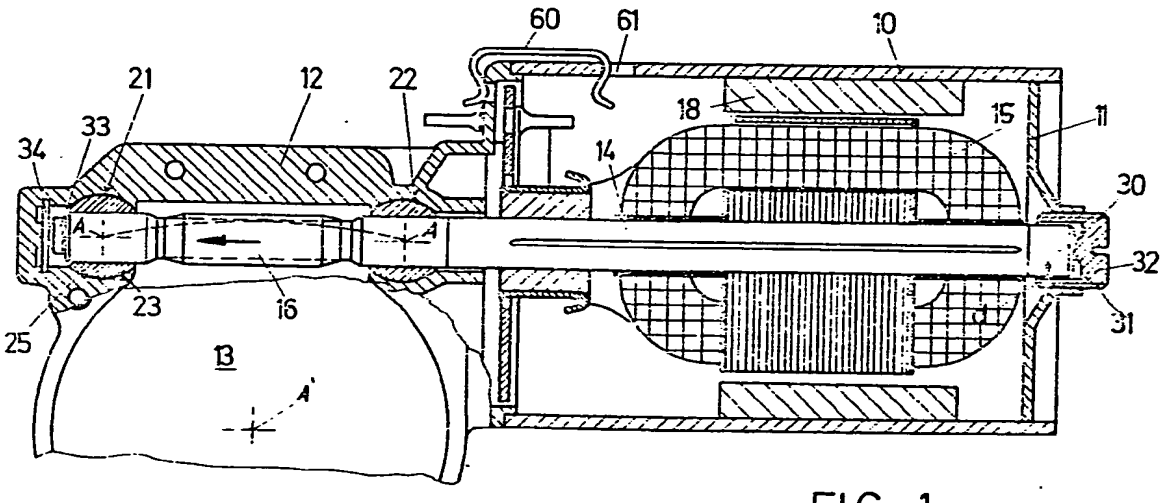

FIG. 1

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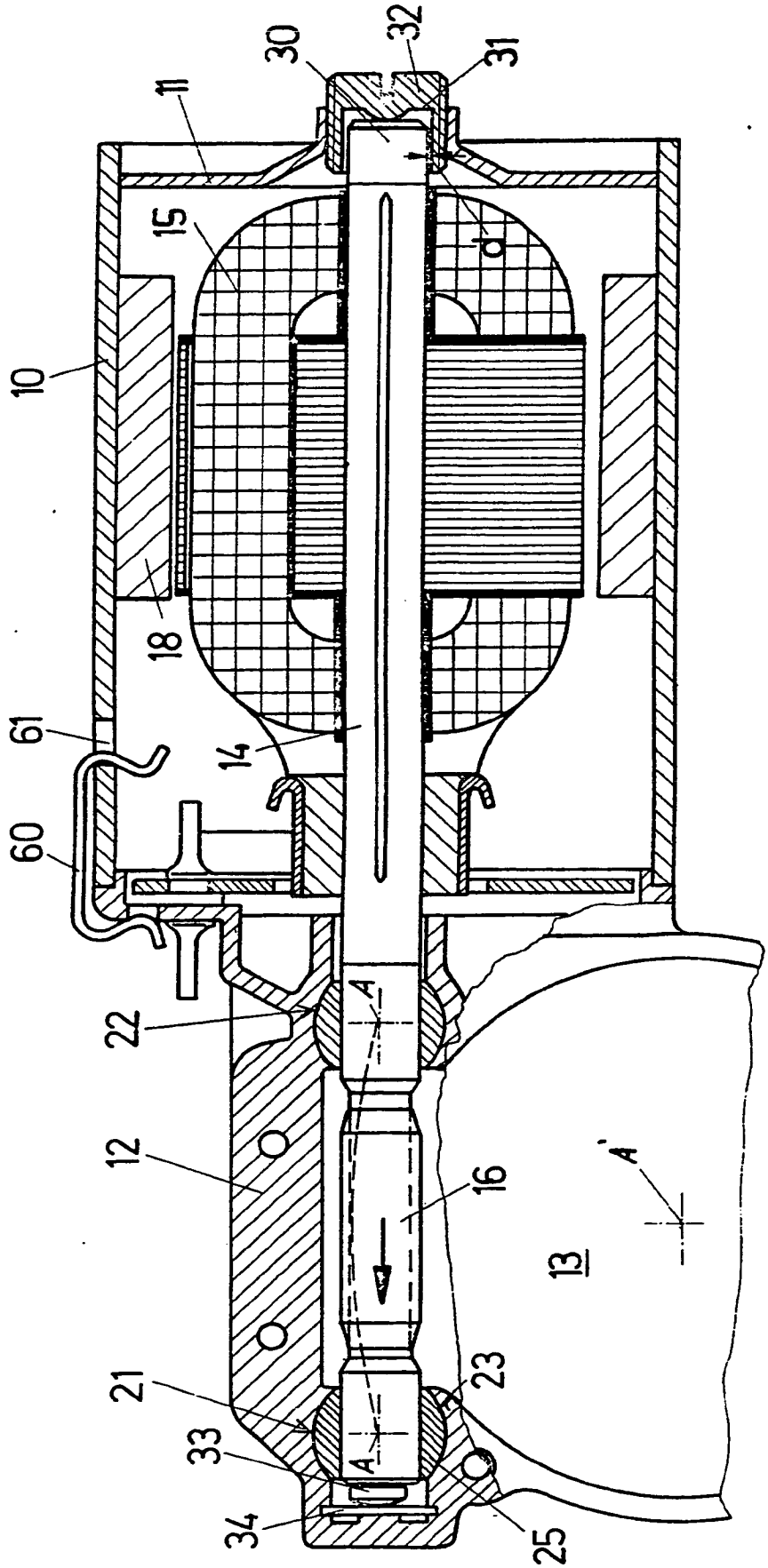

FIG. 1

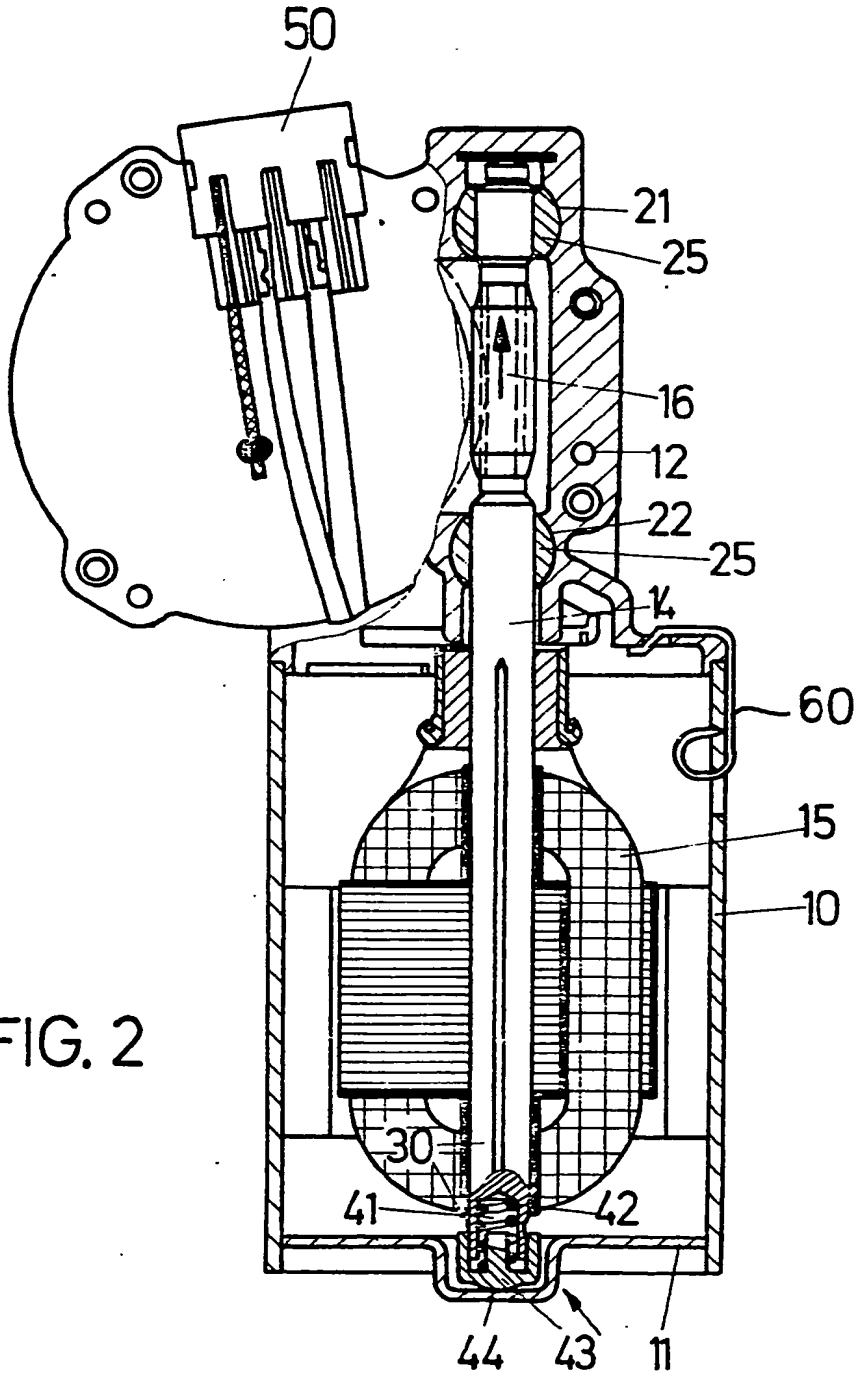

FIG. 2

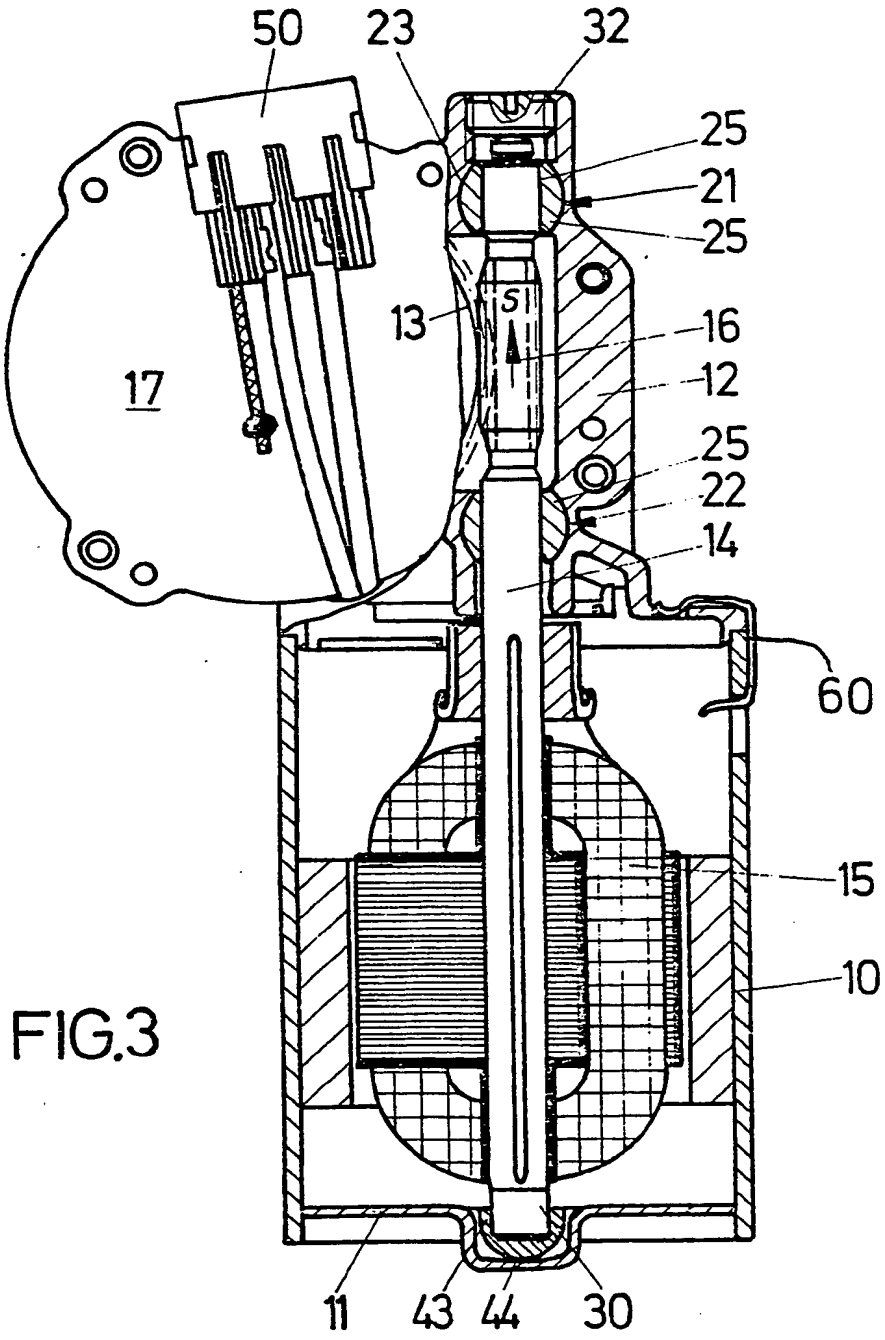

FIG.3

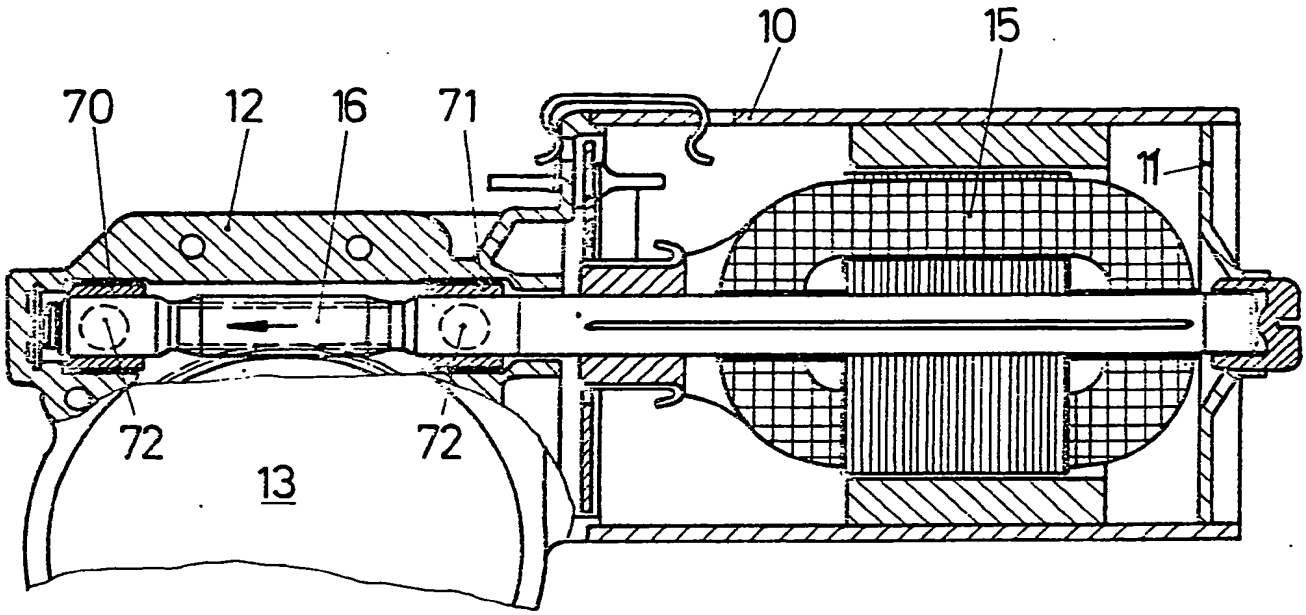

FIG. 5a

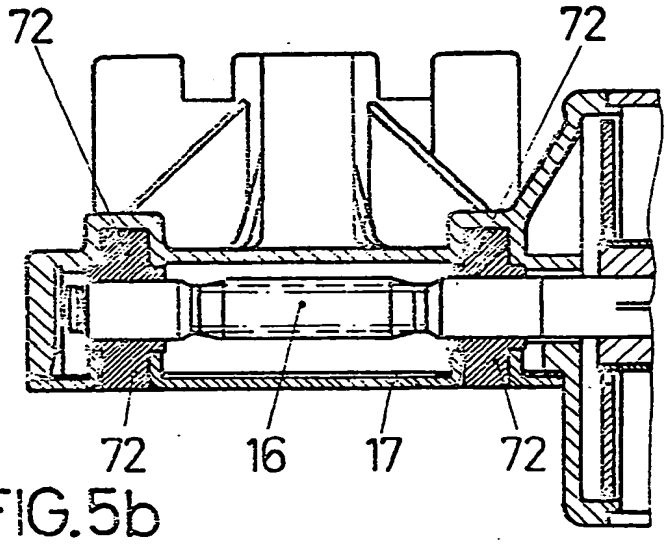

FIG. 5b

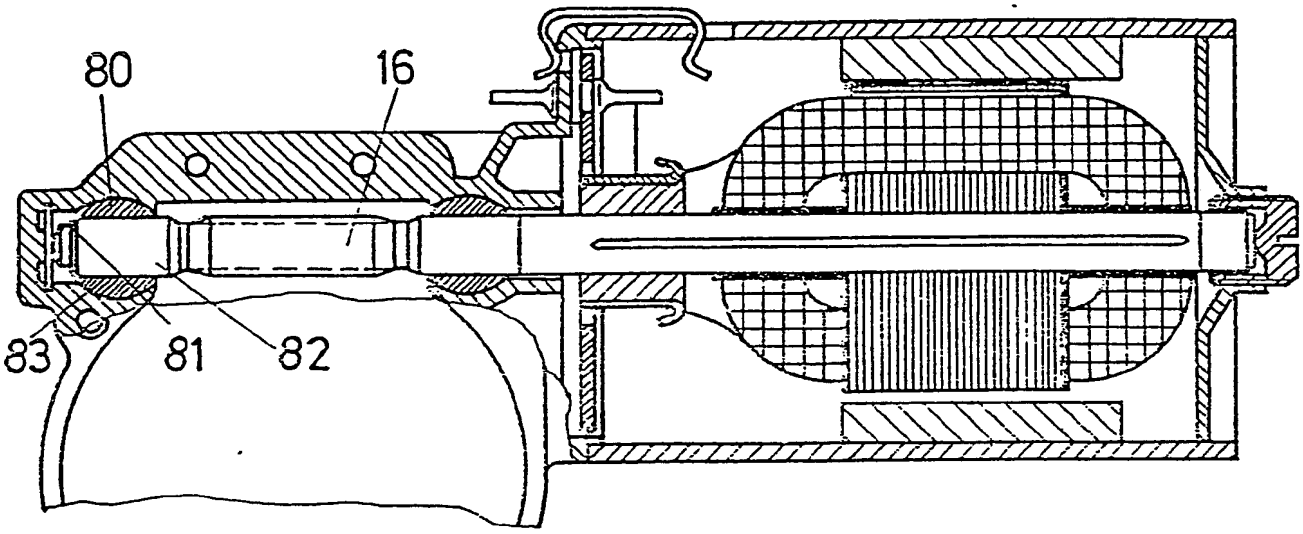

FIG. 6a

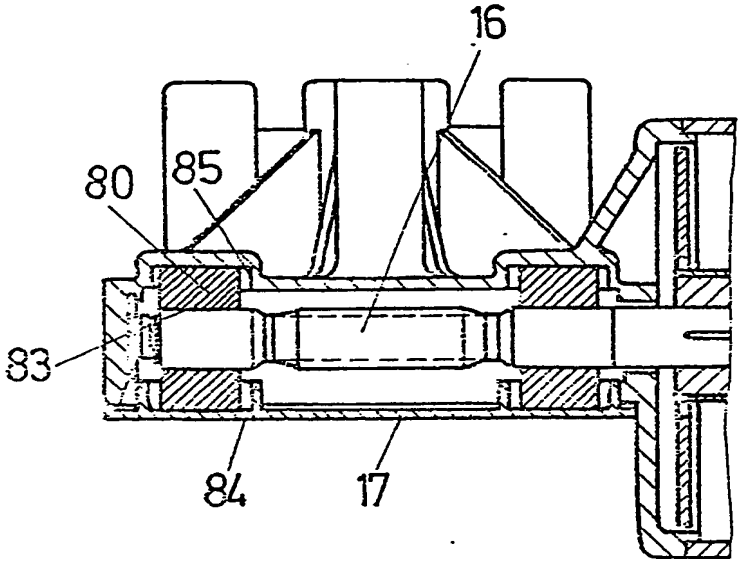

FIG6b

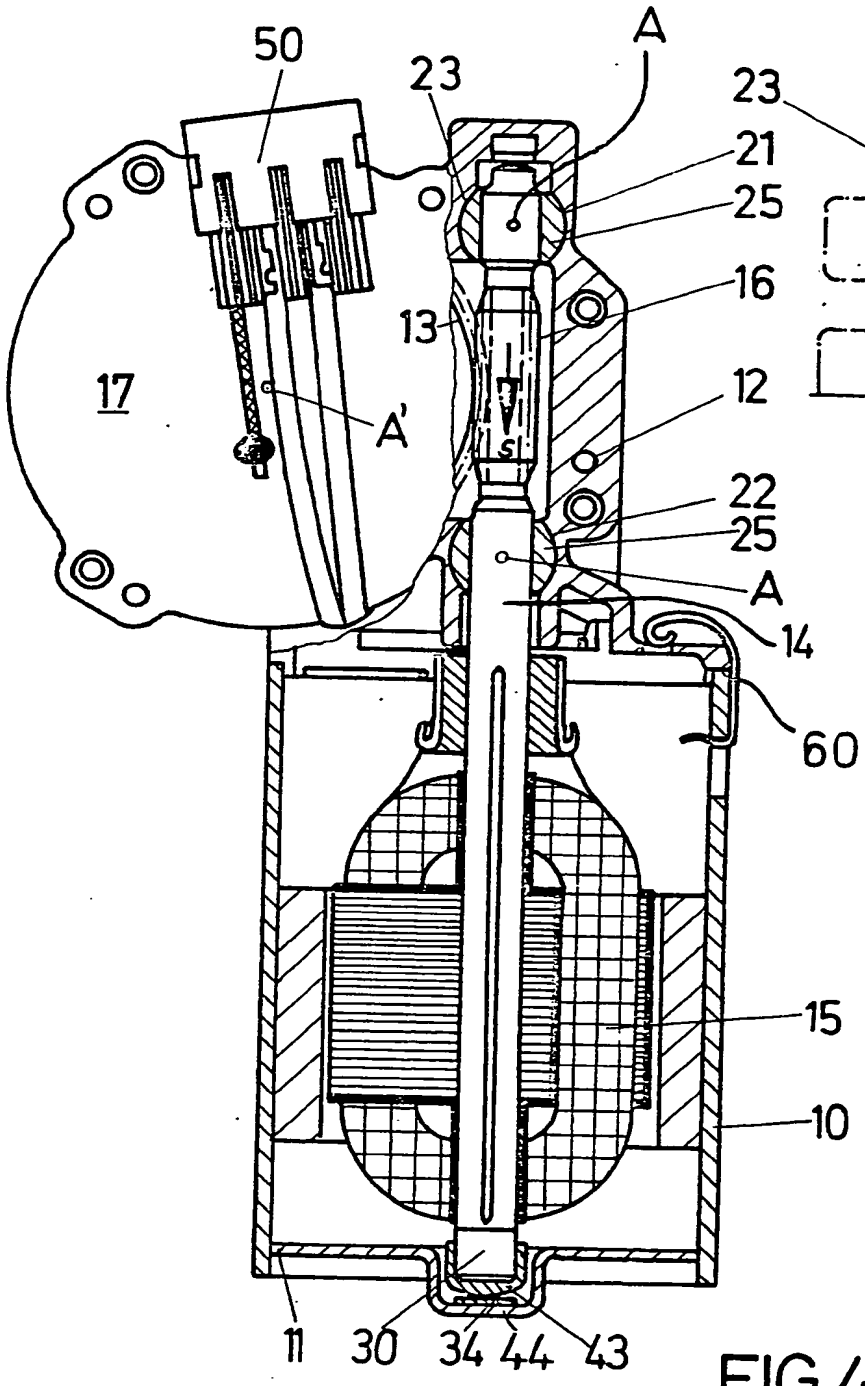

FIG. 4

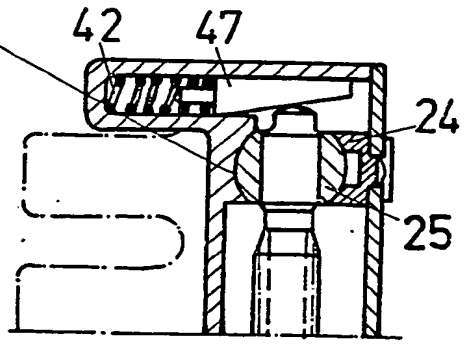

FIG. 7

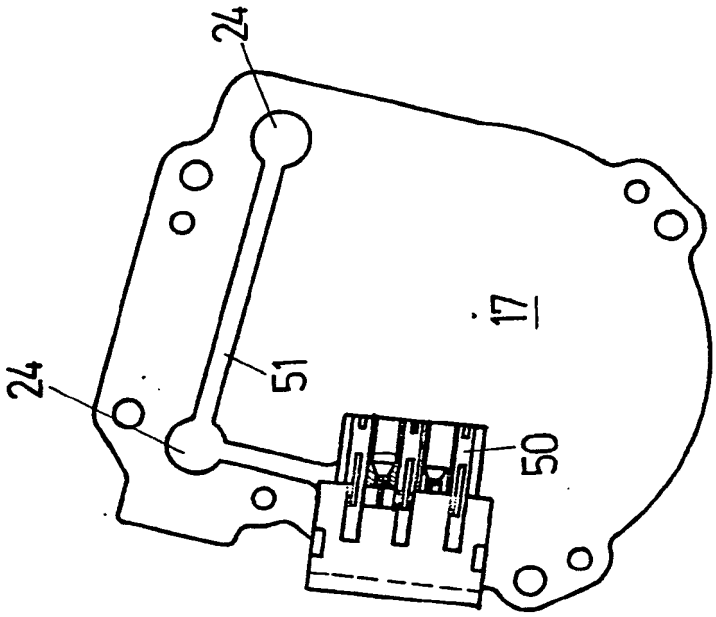

FIG.9

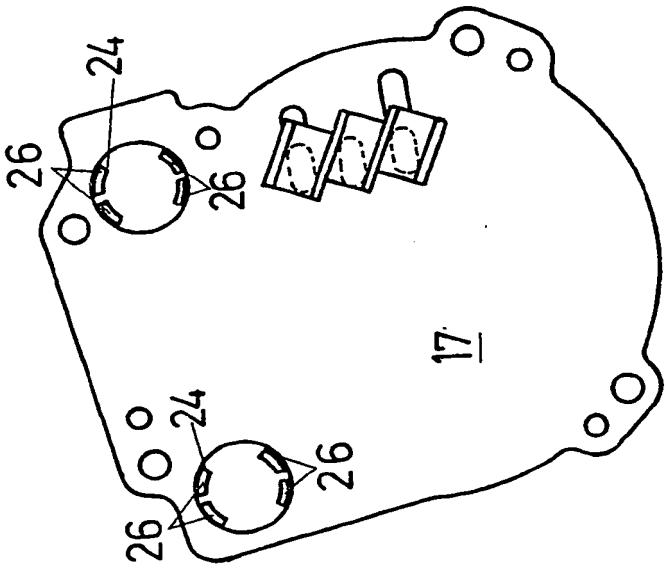

FIG. 8

SPECIFICATION

Electric drive unit

This invention relates to an electric drive unit comprising a motor housing and a gear housing secured thereon, the shaft of an armature mounted in the motor housing projecting into the gear housing, and the shaft being provided with a worm gear toothing which co-operates with a worm wheel mounted in the gear housing.

An electric drive unit for a windscreen wiper is already known in which a motor armature is over-mounted in a motor housing, the armature shaft being guided in two journal bearings in a gear housing. Such a design has the disadvantage that the power take-off side of the armature shaft cants in the firmly fixed journal bearings when it bends in the area of the toothing co-operating with the worm wheel under heavy load.

In a further known type the end of the armature shaft on the motor side is guided in a cap-shaped bearing, and the opposite shaft end extends into an axial bore of an adjusting screw. In this known arrangement a ball bearing is provided which is secured in the gear housing. The efficiency of this arrangement is superior, but a ball bearing is very expensive.

In another known wiper motor two cap-shaped bearings are provided for mounting the armature shaft, one of which guides the end of the shaft on the side of the motor, whereas the other is secured between armature winding and worm-gear toothing in the gear housing. The opposite end of the shaft is supported on an adjusting screw in the gear housing without any lateral guidance. Thus in this arrangement the end of the shaft on the power take-off side gives way laterally under heavy load. Thereby the teeth surfaces can be damaged. The shaft would have to be hardened in order to at least limit this disadvantage, but this would considerably increase the price of the drive unit.

The present invention is based on the problem of developing a drive unit with a better efficiency, especially a wiper motor, and which can be manufactured economically.

According to the present invention there is provided an electric drive unit comprising a motor housing and a gear housing secured thereon, the shaft of an armature mounted in the motor housing projecting into the gear housing, and said shaft being provided with a worm-gear toothing co-operating with a worm wheel mounted in the gear housing, and wherein the armature shaft is guided in self-adjusting bearings provided on opposite sides of the worm-gear toothing.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figs. 1 to 6 show partial longitudinal sections through six embodiments of wiper motors;

Fig. 7 is an enlarged view of a spring element for compensation of end play, and

Figs. 8 and 9 show a front and respectively a back view of a gear housing cover.

Referring firstly to Fig. 1, the wiper motor has a substantially cylindrical or cup-shaped motor housing 10, which on one side is closed by a housing cover 11. The motor housing 10 is secured to a gear housing 12 in which a worm wheel 13 is rotatably mounted. The shaft 14 of an armature 15 projects into the gear housing 12 and has a worm 16 which mates with the worm wheel 13. The armature 15 is over-mounted in the motor housing 10. The armature shaft is only guided by two cap-shaped bearings 21 and 22 which are secured in the gear housing 12 at the same distance from the point of action between worm 16 and worm wheel 13. Each of these cap-shaped bearings 21 and 22 consists of a two-piece ball cup 23, 24 and a universal ball joint 25 which is adjustably held in the ball cup. From Fig. 1 to 4 it is evident that the cup of each cap-shaped bearing is divided in longitudinal direction of the armature shaft 14. The one half 23 of the ball cup is embodied by an appropriate shape of the gear housing 12 made of zinc die-casting. The other half 24 is part of a cover 17 closing the gear housing, as is described in detail hereinafter with reference to Figs. 8 and 9.

The armature shaft 14 by its motor side portion 30 extends with lateral clearance into a bore 31 of an adjusting screw 32 which is adjustably secured on the motor housing cover 11. On the opposite side the armature shaft has a mushroom-shaped plastics elongation 33 supported on a thrust washer 34 made of hard spring steel and anchored at the gear housing 12.

In the embodiments shown in the drawings it is essential that the armature shaft is mounted in the gear housing via two cap-shaped bearings. It has indeed to be considered that during operation, especially under heavy load on the power take-off side, a force is acting on the worm 16 of the armature shaft 14 which causes the worm to bend outwards as is indicated in the drawing in an exaggerated manner by a dotted line. The cap-shaped bearings have the advantage of being able to adjust themselves to the new position and shape of the armature shaft, and especially they can be swivelled round an axle A in parallel to the axis of rotation A' of the worm wheel 13, so that jamming between shaft and bearing and thereby a decreased efficiency will no longer occur. Due to this bending the armature shaft is laterally deflected at the motor side end 30. The clearance *d* between the outside diameter of the shaft 14 and the diameter of the bore 31 is thereby selected in such a way that a sliding of the winding of the armature 15 on the permanent magnets 18 is reliably avoided.

Furthermore it is essential that, because of the special design of the cap-shaped bearings, especially the arrangement of the ball cups, a lateral giving way of the universal ball joints in the sense of enlarging the distance between worm wheel and armature shaft is effectively avoided. The resilient half of the ball cup at most admits that the armature shaft is deflected in parallel to the axis of rotation of the worm wheel, whereas a vertical deflection hereto via the other half of the ball cup is avoided. In the appropriate circumstances it is, of course, imaginable to provide the resilient half of the ball cup in the

housing, but the rigid half in the cover. Finally it could also be imagined to divide the ball cup in longitudinal direction of the armature shaft, but in parallel to the axis of rotation of the worm wheel, whereby on the side of the gear housing and the cover not facing the worm wheel the rigid ball cup half is to be provided, but the resilient ball cup half on the side adjacent to the worm wheel.

In the embodiment according to Fig. 2 the armature shaft is guided in the gear housing 12 also via cap-shaped bearings. The only difference to Fig. 1 is to be seen in the fact that for compensation of the end play a spring element is provided instead of an adjusting screw. The motor side portion 30 of the armature shaft has an axial bore 41, in which a pressure spring 42 is guided. This pressure spring 42 supports on the bottom of a cup-shaped plastics cap 43 which on its part is guided with lateral play in a cylindrical bulge 44 in the motor housing cover 11. Armature shaft 14, pressure spring 42 and plastics cap 43 are locked with each other and form a constructional unit.

In the embodiment according to Fig. 3 over the end portion 30 of the armature shaft 14 a plastics cap 43 is slipped, which is also guided with lateral play in a cylindrical bulge 44 in the motor housing cover 11. On the opposite end of the armature shaft an adjusting screw 32 is provided for compensation for end play.

In the embodiment according to Fig. 4 the spring element has a wedge-shaped slide 47, which is guided in the gear housing 12 transversally to the longitudinal direction of the armature shaft 14 and supported via a pressure spring 42. At the opposite end the armature shaft again has a plastics cap 43, which is supported on a hardened thrust washer 34 at the bottom of cylindrical bulge 44 in the motor housing cover 11. This is important in the embodiment according to Fig. 4, because the axial thrust is effective downwards in direction of arrow *s*, whereas in the embodiments according to Fig. 1 to 3 the axial thrust is effective into the opposite direction, so that the actual support has to be made on the gear housing. Because of this, in the embodiment according to Fig. 1 the thrust washer 34 has to be anchored to the gear housing 12.

In the embodiment according to Figs. 5*a* and *b* two cylindrical bearings 70 and 71 are provided having journals 72 located laterally diametrically opposite to each other. These journals are movably mounted to be rotated round a shaft in bores of the gear housing 12 respectively of cover 17, said shaft again being parallel to the shaft of the worm wheel, so that the bearings can adjust themselves under load, so that even upon deflection of the armature shaft in the area of the toothing canting between armature shaft and cylindrical bearings 70 or 71 will not be possible. In connection with the suitable bore it is thereby simultaneously ensured by the journals 72 that the bearings do not give way laterally, but only can deflect.

Figs. 6*a* and *b* show a similar type. A cylindrical body 80 is flattened on opposite sides 81 and 82 and penetrated by a bore 83. Said cylindrical body is mounted to be swivelled in guides 84 and 85 in the gear housing respectively in the cover.

Fig. 8 shows the back of the gear housing cover 17. The halves 24 of the ball cups are directly injection-moulded in the gear housing cover 17 and comprise four resilient segments 26. From Fig. 9 it can be seen that the two halves 24 of the ball cup via injection-moulded webs 51 are connected as well with each other as also with a plug housing 50. Thus these halves 24 are directly injection-moulded on the gear housing cover 17 in one injection-moulding process with the plug housing 50, which fact entails advantages in production engineering. In the appropriate circumstances it could also be thought of injection-moulding this part, that means the ball cups including the plug housing, as a separate constructional unit and to lock it in the gear housing cover 17.

Especially in the embodiments according to Figs. 1 to 3, in which the axial thrust *s* is intercepted at the gear housing 12 a very simple fastening between gear housing 12 and motor housing 10 is possible. Spring clips 60 lap over the edge of the gear housing 12 and by means of a recess 61 engage in the motor housing 10.

In Figs. 1 to 4 several types of spring clips are shown, although the embodiment according to Fig. 1 is preferred, because the spring clip 60 is symmetrically designed, so that in automatical assembly these spring clips can be easily supplied.

The wiper motor of the present invention in comparison to the known types has a clearly better efficiency. This is achieved by the special type of bearing as well as by the faultless axial support, whereby it is considered that materials with good slide characteristics are resting towards each other. The motor can be produced economically, because no additional stage of manufacture is necessary to produce the cup-shaped bearings 21 and 22. Surprisingly it became obvious that the same efficiency is reached by the embodiments of the present invention as by the much more expensive known design with a ball bearing. In the other known designs a similarly improved efficiency is not possible even when the armature shaft is tempered, hardened or additionally ground.

In accordance with the giving-way motion of the armature shaft a design in which the bearings can be swivelled round at least one shaft in parallel to the axis of rotation of the worm wheel is preferred. Thereby it can be thought of as a journal bearing with lateral projecting journals being mounted in bores of the housing or of the cover. Thereby rigid fixation such as to prevent enlarging of the distance between the armature shaft and the worm wheel is important which is also preferred in a design with particularly advantageous cap-shaped bearings. Thereby the resilient support of the ball cup has to be designed, as described with reference to Fig. 1, in a way that a deflection of the armature shaft is prevented. The ball cup of known embodiments in contrast thereto is normally divided transversally to the axial direction of the armature shaft, whereby in axial direction the universal ball joint at first exercises a pressure on the one half of the ball cup and afterwards can give way laterally.

But the embodiments of Figs. 1 to 4 in comparison

to known solutions also offer advantages in production engineering. Thereby it is in principle actually possible to embody one half of the ball cup by an appropriate shape of the gear housing cover, but a usual cover made of metal sheet does not have the necessary spring characteristic. Therefore an injection-moulded ball cup half is preferred, whereby an injection mould with only one injection nozzle is necessary to form the plug housing and the ball cup halves. Finally, in order to improve efficiency, the end play has to be well compensated. Thereby solutions will be preferred in which the axial thrust released by the toothing between worm wheel and worm is intercepted via the gear housing.

CLAIMS

1. An electric drive unit comprising a motor housing and a gear housing secured thereon, the shaft of an armature mounted in the motor housing projecting into the gear housing, and said shaft being provided with a worm-gear toothing cooperating with a worm wheel mounted in the gear housing, and wherein the armature shaft is guided in self-adjusting bearings provided on opposite sides of the worm-gear toothing.

2. An electric drive unit as claimed in claim 1, wherein the bearings are adapted to be swivelled around at least one shaft parallel to the axis of rotation of the worm wheel.

3. An electric drive unit as claimed in claim 1 or 2, wherein the bearings are rigidly fixed transversally with respect to the armature shaft axis and normally with respect to the axis of rotation of the worm wheel, so that giving way of the bearings in the direction to enlarge the distance between the armature shaft and the worm wheel is avoided.

4. An electric drive unit as claimed in any one of the preceding claims, wherein the bearings are arranged at substantially the same distance from the point of interaction between the worm and the worm wheel.

5. An electric drive unit as claimed in any one of the preceding claims, wherein the bearings are cap-shaped bearings.

6. An electric drive unit as claimed in claim 5, wherein each cap-shaped bearing has a ball cup and a universal ball joint, wherein the ball cup is divided in the longitudinal direction of the armature shaft and one half of the cup is formed by an appropriately designed gear housing and the other half is part of a cover for closing the gear housing.

7. An electric drive unit as claimed in claim 6, wherein the one half of the ball cup is a plastics member which is injection-moulded on the gear cover.

8. An electric drive unit as claimed in claim 7, wherein the plastics half of the ball cup via injection-moulded webs is connected with, a plug housing on the cover of the gear housing.

9. An electric drive unit as claimed in any one of the preceding claims, wherein one end of the armature shaft extends with lateral clearance into a substantially cylindrical bulge in a motor housing cover.

10. An electric drive unit as claimed in claim 9, wherein a plastics cap is slipped over the one end of the armature shaft, whereby said plastics cap is supported on the end of the bulge in the motor housing cover.

11. An electric drive unit as claimed in claim 10, wherein in order to compensate for end play the armature shaft is guided in the longitudinal direction and resiliently supported in the plastics cap.

12. An electric drive unit as claimed in claim 10, wherein the plastics cap is fixedly pressed on to the one end of the armature shaft and in order to compensate for end play a spring element acts upon the other end of the armature shaft.

13. An electric drive unit as claimed in claim 12, wherein the spring element is provided with a wedge-shaped slide which is guided in the gear housing transversally to the longitudinal direction of the shaft and supported via the spring element.

14. An electric drive unit as claimed in any one of claims 1 to 8, wherein one end of the armature shaft which extends with lateral clearance into a bore of an adjusting screw which is adjustably secured on a motor housing cover.

15. An electric drive unit as claimed in any one of the preceding claims, wherein the motor housing is secured to the gear housing by a plurality of spring clips which on the one hand lap over the edge of the gear housing and on the other hand engage into recesses of the motor housing.

16. An electric drive unit as claimed in claim 15, wherein the spring clips are of symmetrical form.

17. An electric drive unit substantially as herein described with reference to and as illustrated in the accompanying drawings.

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